

On Segmentally disposed Thoracic Glands in the Larvæ of the Trichoptera. By GUSTAVE GILSON, Professor of Zoology at the University of Louvain. (Communicated by Prof. G. B. Howes, Sec. Linn. Soc.)

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IN the course of some researches on the silk-glands of the Trichoptera, my attention was attracted by a pointed prominence on the ventral face of the first thoracic segment of the larva.

This chitinous prominence looks very much like the spinneret of certain larval Lepidoptera, though it is usually a little longer than that. In fact it was taken for the spinneret by Réaumur*, who had not detected the very short spinning-tube on the labium. Recently Prof. Miall, in his excellent book on Aquatic Insects †, has recognized that the thoracic plug-like organ is not the spinning-tube (the labial spinneret being known to him). He does not attempt, however, to determine its use and true significance, but declares it to be an organ the function of which is as yet unknown.

A careful dissection of the ventral organs in the fore part of the body led me to the discovery of some very interesting glands, one of which is in connection with the afore-mentioned prothoracic prominence.

In *Phryganea grandis* each of the three thoracic segments bears one of these glands. All three are composed of two bundles of slightly moniliform tubules, lying, on each side, between the outer tunic and the body-wall (fig. 1).

The tubules of each bundle unite to form one main tube which passes obliquely towards the median line, where it joins its fellow of the opposite side to form a common duct. This, in the prothorax, is rather long; it enters the base of the cuticular prominence, at the tip of which it opens through a very tiny aperture. There is a small reservoir at the point of junction of the tubes.

The glands in the meso- and metathorax are almost identical in structure with that of the prothorax, being only a little smaller in size and having a smaller number of tubules. Their common duct is, however, extremely short and opens freely on the

* Réaumur, 'Mémoires pour servir à l'Histoire des Insectes.' Paris, 1734.

† Miall, 'The Natural History of Aquatic Insects,' p. 251. London, 1895.

ventral face, through a very small opening, no spinneret-like organ existing on these two segments. The aperture is extremely difficult to detect from the exterior, even with the help of good lenses, on account of its lying either inside or on the very edge of a deep cuticular fold.

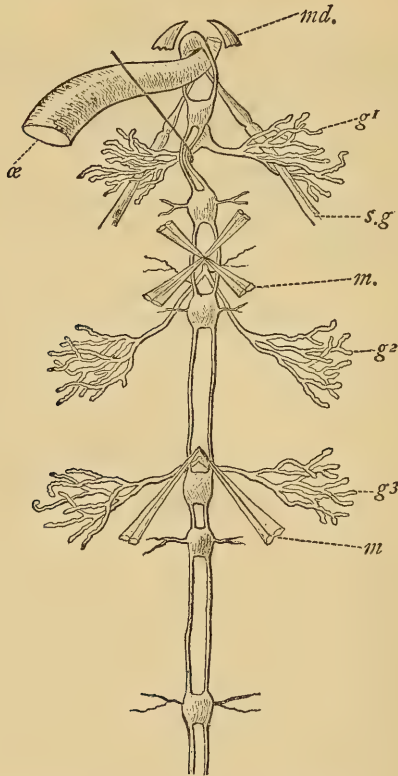


Fig. 1.—*Phryganea grandis*. Dissection (dorsal aspect).

- g^1, g^2, g^3 . Thoracic glands.
 sg . Silk-gland.
 m . Muscles.
 α . Œsophagus.
 md . Mandibles.

In other species, for instance in *Limnophilus flavicornis*, the prothoracic gland is alone represented, and (cf. fig. 2) this single gland differs considerably from that of *Phryganea grandis*. It

consists of a single glandular tube, the inner part of which is composed of large gland-cells, the terminal part being a thin chitinous tube opening at the tip of a very long prominence similar to that of *Phryganea grandis*, between the two prothoracic legs.

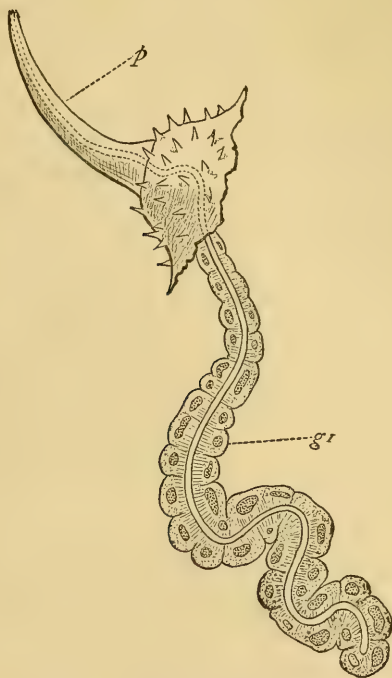


Fig. 2.—*Limnophilus flavicornis*.

Prothoracic gland (g^1) with a part of cuticle bearing the plug-like organ (p).

The meso- and metathorax contain no gland, and no trace of a prominence is to be seen on their ventral face.

The structure of the tubules is the same in all segments. The glandular epithelium consists of a small number of large cells, the central lumen being lined by a strong chitinous membrane. This cuticle, or so-called *intima*, is quite smooth and entirely devoid of pores or any kind of apertures through which the secretory product could be supposed to flow out of the cells. The presence of such a non-porous lining to a glandular tube is a remarkable feature of these organs, though not an unknown one amongst the Tracheata.

The secretion is not miscible with water, and presents the appearance of an oily fluid, though it is undoubtedly very different from a fatty substance in the chemical sense of the term.

These remarkable organs seem to deserve closer investigation and minute description. Being engaged in other work, I have asked one of my pupils, Dr. Henseval, to take up the subject. He will shortly publish a paper dealing with these glands and several others, as well as with the results of his researches on the chemical nature of the "oil" produced by the maxillary glands of *Cossus ligniperda**, a substance which seems to be identical with that excreted by the thoracic glands of Trichoptera.

A peculiar interest attaches to these thoracic glands of the larval Trichoptera, in its possible bearing on the question of persistence of Annelidan features in the Tracheata.

That they are newly acquired or adaptive organs, arising in relation with the tubicolous habit, seems very unlikely, for if the mere utility of their oily product is sufficient to account for their appearance and development into important organs, there seems to me no reason why they should be segmentally repeated. One single gland, no matter where it lay, could furnish a suitable quantity of "oil" quite as well as the three moderately large glands lying in close proximity to one another but on separate segments.

There is an organ undoubtedly homologous with the thoracic glands of Trichoptera which has obviously nothing to do with tubicolous life, *i. e.* the ventral gland, "Bauchdrüse," described by Professors Poulton and Schäffer in certain non-tubicolous caterpillars.

It appears to me, therefore, much more probable that the thoracic glands are inherited organs; and that the aquatic and tubicolous habits of the larva may account for their preservation.

The question then presents itself, with which of the segmentally disposed organs of Annelids and *Peripatus* are the thoracic glands of Trichoptera to be considered homologous?

Only two kinds of organs may possibly be considered ancestral to these glands—the nephridia and the coxal glands. If the thoracic glands could be wholly or in part recognized as mesoblastic in origin, little doubt would remain as to their nephridial

* This paper was published during the passage of these pages through the printers' hands, under the title "Étude comparée des Glandes de Gilson," 'La Cellule,' tome ix. pp. 329-354.—Ed.

relationship. But this is not the case: nothing is known of the development of these till lately undiscovered organs. And if they were known to be epiblastic, as they probably are, it would not settle the question, as they could then be the remains of the outer part of the nephridia which so often originates as an epiblastic ingrowth, the mesoblastic or proper nephridial part having vanished in the course of evolution. No conclusion could be drawn against their nephridial relationships, whatever might be their origin. They appear to me, however, to be more likely nephridial than coxal, for the following reasons:—

1. They have no connection with the appendages. This fact, though not finally disposing of belief in their coxal nature, seems worth consideration, as no organ *undoubtedly coxal* is known to have moved far from the limb and met its fellow in the median line.

2. On the other hand, certain organs, the *nephridial* significance of which it is scarcely possible to doubt, unite in the median line and open there through one common aperture. Such are the so-called "salivary glands" of *Peripatus*. These are long tubes entirely disconnected in the embryo, and provided each with a funnel or nephrostome. Later on they lose their inner opening, and meet at the median line, just as the thoracic glands do in Trichoptera. The same is true of the disposition of the silk-glands of larval insects and, in many an adult form, of the true salivary glands, both being considered as modified nephridia.

3. There is a striking analogy between the arrangement of the tubules of the thoracic glands of Trichoptera and that of the Malpighian vessels generally. Both are derivatives of two chief tubes (at least this is the primitive disposition of the Malpighian vessels). These chief canals open in both cases through a single epiblastic ingrowth, and the common duct of the thoracic glands would thus appear to be equivalent in its relationships to the proctodæum. We have now much reason for regarding the Malpighian vessels as modified nephridia; and Gegenbaur's hypothesis that these vessels primitively opened on the surface of the body has received a strong confirmation from the fact, discovered by Wheeler*, that in *Doryphora* they early appear in the form of ingrowths from the walls of the proctodæum, while this

* Wheeler, "The Embryology of *Blatta germanica* and *Doryphora decemlineata*." 'Journal of Morphology,' vol. iii. 1889.

epiblastic invagination is still very shallow. Their nephridial significance, suggested already by their excretory function, is thus supported by serious morphological considerations.

The similarity of structure between the Malpighian nephridia and the glands here noticed seems thus to plead in favour of the nephridial character of the latter.

No trace of *segmentally repeated* organs, be they coxal or nephridial, has been hitherto detected, so far as I am aware, on the thoracic segments of the Hexapoda. Even in the lowest forms of insects (Thysanura), where remains of segmental organs, probably coxal, may be detected on all the abdominal segments *, no trace whatever of such organs is known on the thoracic, with the exception of the single "Bauchdrüse" in the prothorax of certain Lepidoptera, and some scent-glands in certain Hemiptera. It is thus worthy of remark that in Trichoptera each of the thoracic segments of the larva may possess a gland, and in its segmental repetition they reveal an ancestral character that could not be affixed with security to the single "Bauchdrüse" or to the scent-glands. There is thus possibly no segment of the Hexapod body left that can be said to be completely wanting in traces of segmental organs in some member of the group.

Conclusion.

1. In the larval Trichoptera each of the thoracic segments may be provided with more or less complex glandular organs more nearly representing nephridia than the coxal glands of Annelids and *Peripatus*. By the discovery of these it may now be said that :

2. In the Hexapoda remains of segmentally disposed glandular organs, be they coxal or nephridial, are known for the whole length of the body, from the mandibular to the posterior abdominal segments.

* Oudemans, 'Beiträge zur Kenntniss des Thysanuræ und Collembolæ,' Berlin, 1888.
